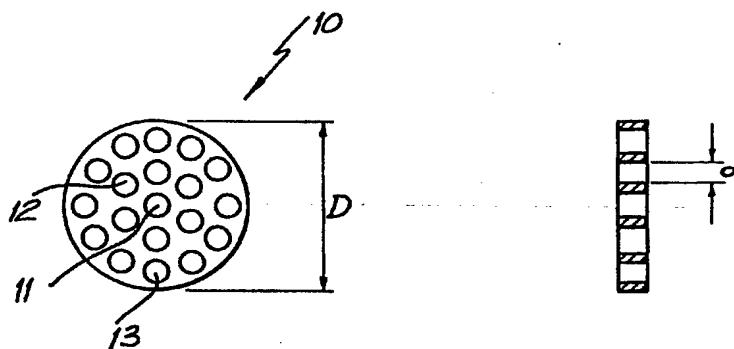




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## (54) Title: FLUID FLOW CONDITIONER



## (57) Abstract

A fluid flow conditioning plate (10) for removing swirl, etc. from an enclosed water stream especially for a fire fighting nozzle. The plate has circular holes lying on concentric circles (11, 12, 13). Two cross-sectional shapes for the holes are suggested. They may have a short upstream end tapering inwardly in the direction of the flow then a substantially longer portion of constant cross section and finally a short downstream end tapering outwardly in the direction of the flow. In the alternative the portion of constant cross section is shortened to accommodate a longer downstream end portion, of conical or trumpet shape, which acts as a diffuser. Various examples of ratios of hole to plate diameters, etc. are given as are examples of fog nozzles incorporating flow conditioners.

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FLUID FLOW CONDITIONERFIELD OF THE INVENTION

This invention relates to flow conditioners for fluid nozzles or for fluid measurement.

5 For the sake of convenience, the invention will be described in relation to flow conditioners for jet type fire fighting water nozzles but it is to be understood that the invention is not limited thereto as it may be applied to other areas of fluid flow such as fluid jets for 10 fountains or fluid measurement.

BACKGROUND ART

Prior art flow conditioners include the vane type and the tube bundle type both of which are located in the fluid stream. A common use of such flow conditioners is to 15 condition the water stream for jet type fire fighting streams. Although these prior art conditioners are very effective at removing swirl from the water, they are less successful in conditioning other fluid flow properties.

Another kind of prior art flow conditioner is the 20 single plate conditioner which consists of a circular plate having an array of 36 fluid passageways therethrough. Each passageway is tapered inwardly in the direction of the fluid flow and around the downstream end of each passageway is a tube which is typically 0.13 times the diameter of the 25 plate. The thickness of the plate plus the tubes is also typically 0.13 times the diameter of the plate.

SUMMARY OF THE INVENTION

It is an object of the invention to provide improved

plate type flow conditioners which are simpler to manufacture than prior art plate type flow conditioners and which provide better performance than those prior art flow conditioners.

5 It is a further object of the invention to provide a modified single plate flow conditioner for use in an adjustable spray pattern nozzles such as fog nozzles of the kind used in fire fighting.

10 According to one aspect of the invention there is provided a fluid flow conditioner comprising a plate having a plurality of fluid passageways therethrough, each fluid passageway having an upstream end that is tapered inwardly in the direction of fluid flow and a downstream end that is tapered outwardly in the direction of fluid flow.

15 According to another aspect of the invention there is provided a fluid flow apparatus comprising a nozzle having a nozzle piece, a pipe or body portion and a coupling flange and a fluid flow conditioner according to the invention.

20 BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more readily understood and put into practical effect, reference will now be made to the accompanying drawings in which:-

25 Fig. 1 is a front elevational view of a plate-type flow conditioner according to one embodiment of the invention,

Fig. 2 is a side elevational view of the flow conditioner shown in Fig. 1,

Fig. 3 is a front elevational view of a plate-type flow conditioner according to a second embodiment of the invention,

Fig. 4 is a front elevational view of a plate-type flow conditioner according to a third embodiment of the invention,

5 Fig. 5 is an enlarged cross-sectional view of one kind of flow passageway of the plates shown in Figs. 1 to 4,

10 Fig. 6 is an enlarged cross-sectional view of a second kind of flow passageways for the plates shown in Figs. 1 to 4,

Fig. 7 is a cross-sectional view of a jet-type water nozzle incorporating a plate-type flow conditioner according to the invention in the body of the nozzle,

15 Fig. 8 is a cross-sectional view of a jet type water nozzle incorporating a plate type flow conditioner according to the invention with the conditioner located in the coupling of the nozzle,

20 Fig. 9 is a cross-sectional view of a fog type water nozzle incorporating a plate type flow conditioner according to the invention,

25 Fig. 10 is a plan view of the plate type flow conditioner of the fog type nozzle shown in Fig. 9,

Fig. 11 is a front elevational view of a plate-type flow conditioner according to a fourth embodiment of the invention,

5 Fig. 12 is a side elevational view of the flow conditioner shown in Fig. 11, and

Fig. 13 is a cross-sectional view of a nozzle having co-axial proportioners incorporating a flow conditioner of the kind shown in Figs. 11 and 12.

10 DESCRIPTION OF THE PREFERRED EMBODIMENT

The single plate-type flow conditioner shown in Figs. 1 and 2 consists of a plate 10 that has a diameter D. There is a central fluid passageway 11, an inner array of six fluid passageways 12 and an outer array of twelve fluid 15 passageways 13. The fluid passageway arrays 12 and 13 are located on circles which are concentric with the centre of the central fluid passageway 11. As shown in Fig. 2, each fluid passageway has a diameter d.

20 The flow conditioner 16 shown in Fig. 3 is similar to that shown in Fig. 1 and 2 except that there is a further outer array of 18 fluid passageways 14 located on a circle which is also concentric with the centre of the passageway 11.

25 The flow conditioner 17 shown in Fig. 4 is similar to that shown in Fig. 1 and 2 except that there is a further outer array of 24 fluid passageways 15 located on a circle which is also concentric with the centre of the passageway 11.

The fluid passageways are spaced evenly over the area of the plate so as to allow for easy manufacture. The number of holes per circle is only approximate and it appears not to be very important that a number of holes be 5 left out in the outer circles thereby making manufacture slightly easier.

The diameter  $d$  of the fluid passageways depend on the number of passageways used in the flow conditioner. For the 19 passageway flow conditioner 10 shown in Figs. 1 and 10 2, the passageway size should be in the range of 0.1 to 0.18 times the diameter of the plate  $D$ . For the 37 passageway conditioner 16 shown in Fig. 3, the passageway size should be in the range 0.08 to 0.13 times the diameter of the plate  $D$ . For the 61 passageway conditioner 17 shown 15 in Fig. 4, the passageway size should be in the range of 0.05 to 0.1 times the diameter of the plate  $D$ . It is not essential that all the passageways be of the same size but manufacture is simpler if all the passageways are of the same size.

20 The thickness of the plate 10 will depend upon the diameter  $d$  of the passageways. The thickness of the plate 10 must be a minimum of 0.6 times the diameter  $d$  of the passageways with the ultimate being between 1.0 and 1.7 times the diameter  $d$  of the passageways. Structural 25 considerations will influence the choice of plate thickness.

The performance of a water jet nozzle depends on the number of fluid passageways. As the number of passageways

increases, the quality of the water jet increases. The minimum requirement is 19 passageways to produce a water jet that is visibly superior to the vane or tube bundle type flow conditioners of the prior art.

5 Increasing the number of holes beyond 19 to 37 and 61 has less effect on the quality of the water jet, however, the spacing between the flow conditioner must be reduced for optimum performance. The shortening of the nozzle/flow conditioner assembly is one of the principle advantages of  
10 the invention.

The geometry of alternative fluid passageways is shown in Figs. 5 and 6. As can be seen in Fig. 5, the upstream end 20 of the fluid passageway 11 is tapered inwardly in the direction of fluid flow and the downstream end 21 of the passageway 11 is tapered outwardly in the direction of fluid flow. The central portion 22 of the passageway 11 is of constant cross-section and is substantially longer than either of the upstream end 20 or the downstream end 21.  
15

The upstream end 30 of the passageway 11 shown in Fig. 6 tapers inwardly in the direction of fluid flow. Adjacent to the inlet end 30 there is a smaller mid portion of the passageway 31 of constant cross-section and to the right of the mid portion 31 there is an outwardly tapering diffusion portion 32. The diffuser portion 32 is substantially longer than either the upstream portion 30 or the mid portion 31. In this instance, the diffuser portion is at least 0.3 times the thickness of the plate 10 and the mid portion 31 is from 0.2 to 0.5 times the diameter  $d$  of the  
20  
25

passageway. In this instance, each upstream end 20 and downstream end 21 is 0.1 times the diameter  $d$  of the passageway.

5 The geometry of the passageways has significant advantages including improved performance. For large diameter flow conditioners (100 mm and above), all passageways can be cast into the plate and the diffuser side of the passageway of the Fig. 6 embodiment requires no machining. For small diameter flow conditioners, the plate 10 can be moulded or cast in a convenient plastics material. The included angle for the diffuser portion 32 of the Fig. 6 embodiment should be in the range of 0 to 15 degrees with 6 to 10 degrees being preferred. The diffuser could be trumpet shaped instead of conical.

15 Figs. 7 and 8 show a fire fighting nozzle having a flow conditioner 10 of the invention positioned within a nozzle 40 having a nozzle piece 41, a pipe or body portion 42 and a coupling flange 43.

With the 19-hole flow conditioner 10 of Figs. 1 and 2, 20 the spacing  $S$  between the flow conditioner 10 and the nozzle piece 41 must be a minimum of seven pipe diameters. For the 37-passageway conditioner shown in Fig. 3, the spacing  $S$  must be between 4 and 7 pipe diameters. The use 25 of shorter or longer spacing with the 37-passageway conditioner of Fig. 3 causes loss of performance.

The flow conditioner 10 may be incorporated into other fire fighting nozzles such as an adjustable spray pattern nozzle or a fog nozzle 50 as shown in Fig. 9. The fog

nozzle 50 has a coupling flange 51, a pipe or body portion 52, an adjustable nozzle piece 53 and a stem 54. In this instance, the flow conditioner 10 is used as a retaining plate for the stem 54 which has a threaded end which engages in a correspondingly threaded wall of the central passageway 11.

A flow conditioner of the invention may be incorporated into many variations of the fog nozzle including those fitted with co-axial type proportioners. A flow conditioner used in this manner must have a minimum of six holes with the preferred number being 36. The use of six holes produces little or no improvement in performance unless the water entering the nozzle is very turbulent.

A flow conditioner 60 suitable for use with a nozzle having co-axial proportioners is shown in Figs. 11 and 12. The flow conditioner 60 has a central bore 63 and two concentric arrays 61 and 62 of passageways. The inner array 61 has 18 passageways and the outer array 62 has 24 or 25 passageways. In this instance, the plate 60 is 18 mm thick and has a diameter of 152 mm and each passageway has a diameter of 16 mm and each upstream end and downstream end is 2 mm long.

The co-axial type nozzle 70 shown in Fig. 13 incorporates a flow conditioner 60 of Figs. 11 and 12. The nozzle 70 includes a proportioner element 71, a coupling 72, a nozzle body 73, and a shaper 74. Within the shaper 74 there is a stem 75 having a steamhead 76 and stemplate 77. The conditioner 60 is located within nozzle body 73.

Various modifications may be made in details of design and construction of the flow conditioner without departing from the scope and ambit of the invention.

CLAIMS

1. A fluid flow conditioner comprising a plate having a plurality of fluid passageways therethrough, each fluid passageway having an upstream end that is tapered inwardly in the direction of fluid flow and a downstream end that is tapered outwardly in the direction of fluid flow.  
5
2. A fluid flow conditioner according to claim 1 wherein each fluid passageway has a portion of constant cross-section between the upstream end and the downstream end.  
10
3. A fluid flow conditioner according to claim 2 wherein the constant cross-section portion is substantially longer than the tapered upstream end or the tapered downstream end.  
15
4. A fluid flow conditioner according to claim 2 wherein the tapered downstream end is substantially longer than the tapered upstream end or the portion of constant cross-section.  
20
5. A fluid flow conditioner according to claim 4 wherein the tapered downstream end is a diffuser.  
25
6. A fluid flow conditioner according to claim 5 wherein the diffuser is of conical shape.

7. A fluid flow conditioner according to claim 6 wherein the included angle of the conical shaped diffuser is in the range of 0 to 15 degrees.

5 8. A fluid flow conditioner according to claim 6 wherein the included angle of the conical shaped diffuser is in the range of 6 to 10 degrees.

10 9. A fluid flow conditioner according to claim 6 wherein the diffuser is trumpet shaped.

15 10. A fluid flow conditioner according to any one of the preceding claims having a central fluid passageway, an inner array of six fluid passageways and an outer array of 12 fluid passageways, the inner and outer arrays being located on circles which are concentric with the centre of the central passageway.

20 11. A fluid flow conditioner according to claim 10 and further including another array of passageways located on a circle which is concentric with the centre of the passageways and which is located radially outwardly from the outer array.

25 12. A fluid flow conditioner according to claim 11 and further including another array of passageways located on a circle which is concentric with the centre of the

passageways and which is located radially outwardly from the outer array.

13. A fluid flow conditioner according to any one of claims 5 1 to 9 having a central bore and inner and outer concentric arrays of passageways.

14. A fluid flow conditioner according to any one of claims 10 1 to 13 wherein the diameter of each fluid passageway is in the range of 0.1 to 0.18 times the diameter of the plate.

15. A fluid flow conditioner according to any one of claims 1 to 13 wherein the diameter of each fluid passageway is in the range of 0.8 to 0.13 times the diameter of the plate.

15

16. A fluid flow conditioner according to any one of claims 1 to 12 wherein the diameter of each fluid passageway is in the range of 0.05 to 0.1 times the diameter of the plate.

20

17. A fluid flow conditioner according to any one of the preceding claims wherein the thickness of the plate is within the range of 0.6 to 1.7 times the diameter of each passageway.

25

18. A fluid flow conditioner according to claim 2 wherein the upstream end and downstream end of each passageway is 0.1 times the diameter of the passageway.

19. A fluid flow conditioner according to claim 5 wherein the diffuser is 0.3 times the thickness of the plate.

20. A fluid flow conditioner according to claim 19 wherein  
5 the portion of constant cross-section is from 0.2 to 0.5 times the diameter of the passageway.

21. A fluid flow apparatus comprising a nozzle having a nozzle piece, a pipe or body portion and a coupling flange  
10 and a fluid flow conditioner according to any one of claims 1 to 20.

22. A fluid flow apparatus according to claim 21 wherein the fluid flow conditioner is located in the pipe or body  
15 portion of the nozzle.

23. A fluid flow apparatus according to claim 22 wherein the fluid flow conditioner is located in the coupling flange.

20

24. According to any one of claims 21, 22 or 23 and further including a stem portion connected to the central passageway of the fluid flow diffuser whereby the fluid flow apparatus constitutes a fog nozzle.

25

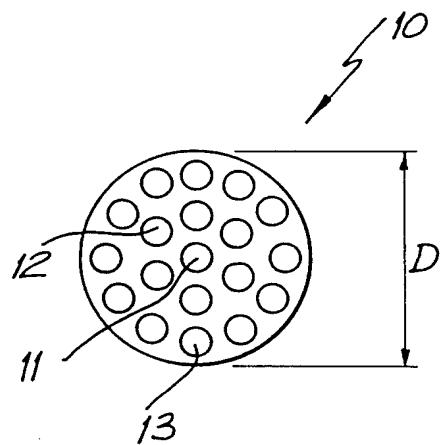


FIG. 1

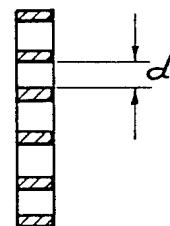


FIG. 2

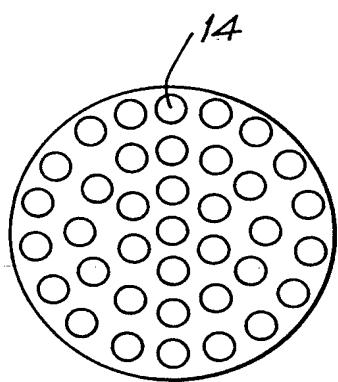


FIG. 3

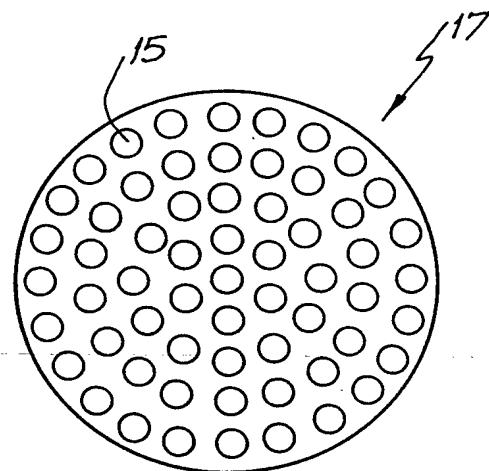


FIG. 4

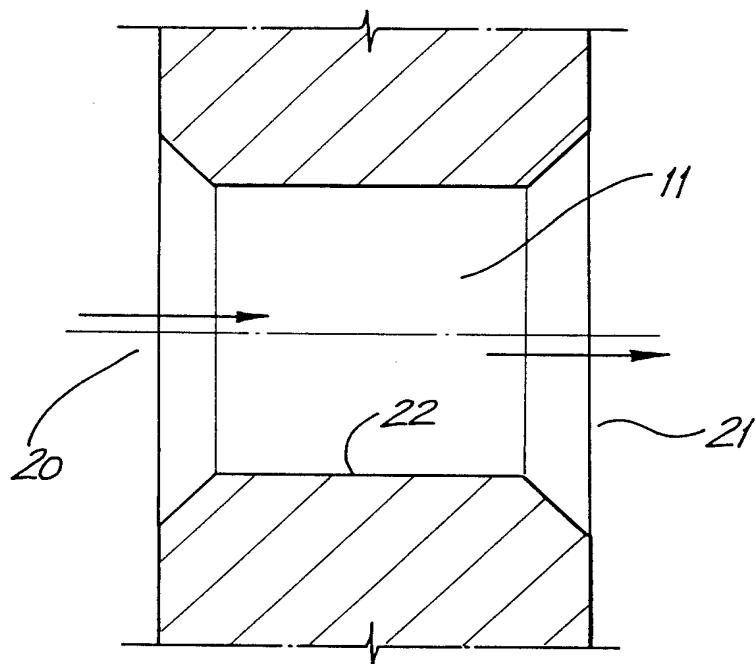


FIG. 5

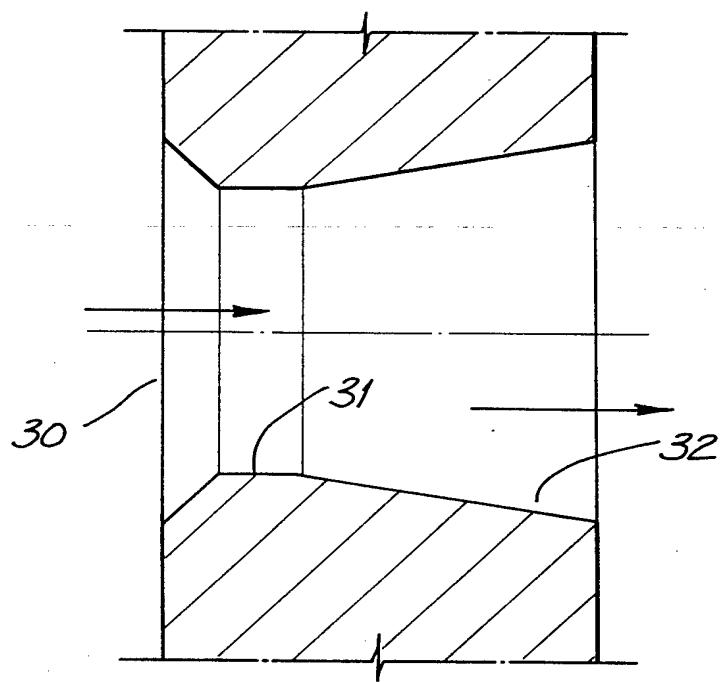


FIG. 6

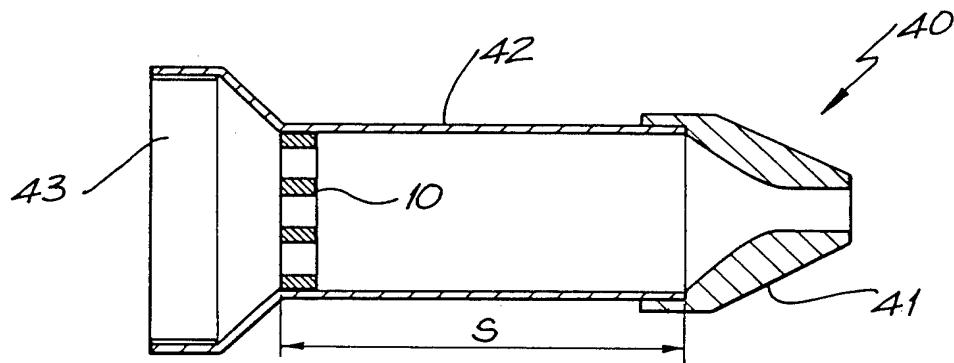


FIG. 7

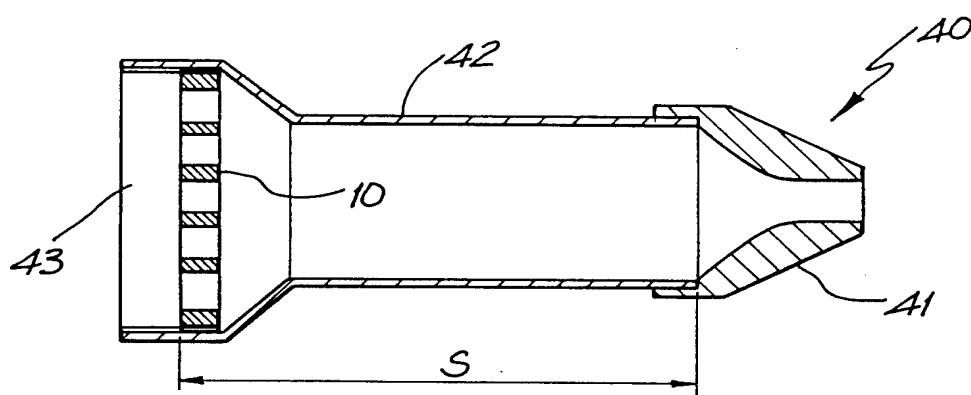


FIG. 8

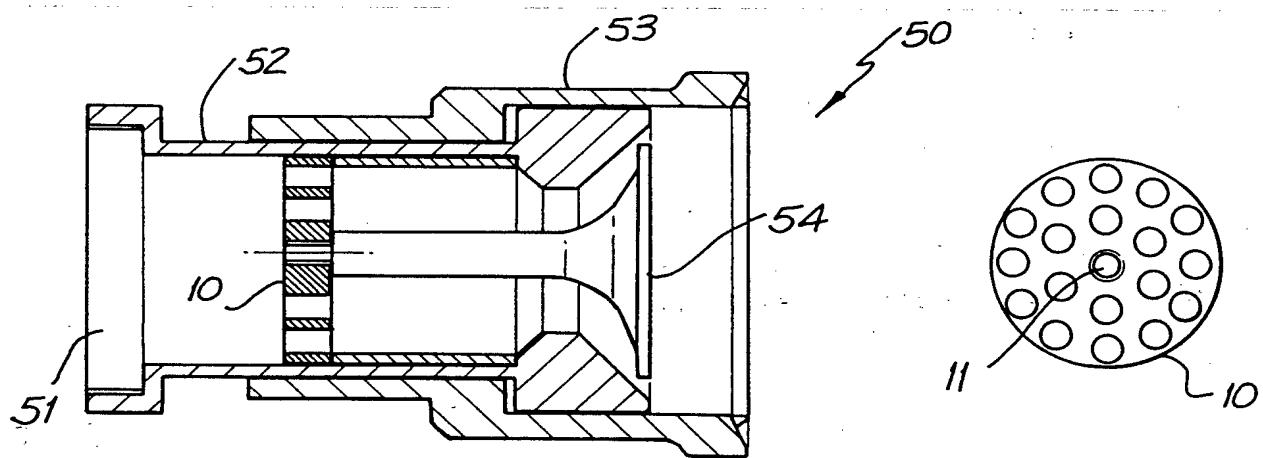


FIG. 9

FIG. 10

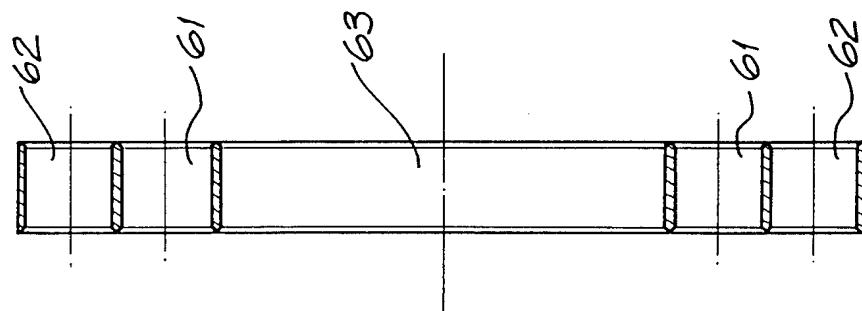


FIG. 12

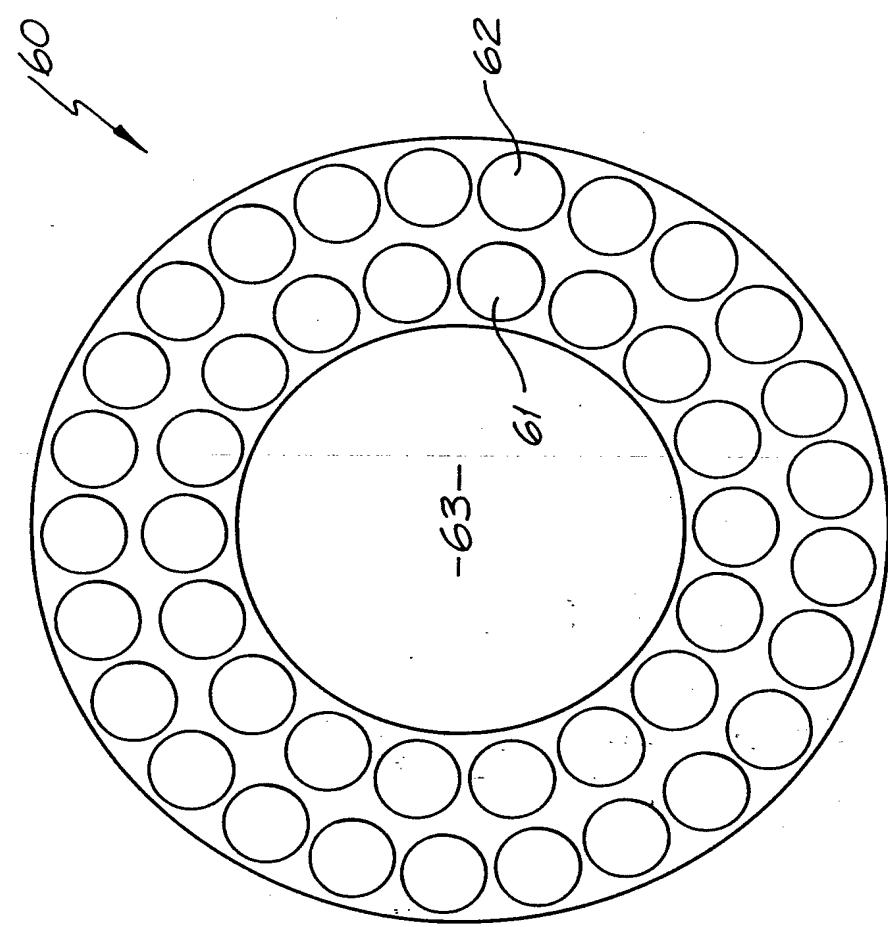
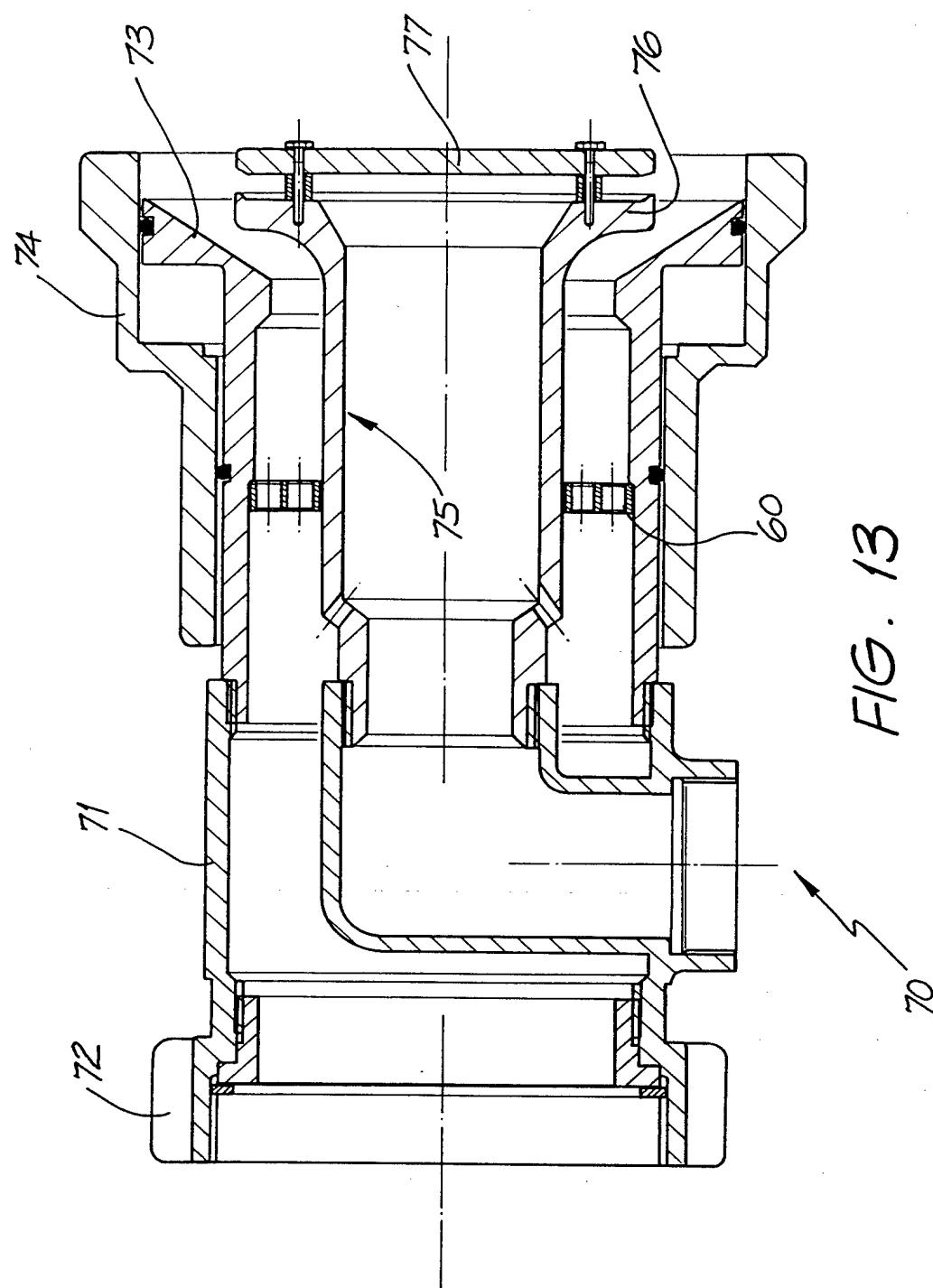


FIG. 11



**A. CLASSIFICATION OF SUBJECT MATTER**  
Int. Cl.<sup>6</sup> F15D 1/02 B05B 1/34 A62C 3/02

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC F15D 1/02 B05B 1/34 A62C 31/02, 31/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
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**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
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Y		10-15, 17
Y	WO,A, 91/01452 (SALFORD UNIVERSITY BUSINESS SERVICES LTD) 7 February 1991 (07.02.91)	10-15, 17
X	FR,A, 2143866 (WESTINGHOUSE ELECTRIC CORP.) 9 February 1973 (09.02.73)	1, 2, 4-6
X	Patent Abstracts of Japan, M1610, page 75 JP,A, 6-47669 (BABCOCK HITACHI K.K.) 22 February 1994 (22.02.94)	1-3, 18

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Date of the actual completion of the international search 7 March 1995 (07.03.95)	Date of mailing of the international search report 1b Mar 1995 (16.03.95)
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
X	WO,A, 93/11908 (DIAT) 24 June 1993 (24.06.93)	1-3, 21
X	WO,A, 87/07853 (BRONZAVIA - AIR EQUIPMENT) 30 December 1987 (30.12.87) See in particular Figs 6a,b.	1, 2, 4-6
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A	WO,A, 89/09654 (POOK) 19 October 1989 (19.10.89)	
A	US,A, 3572391 (HIRSCH) 23 March 1971 (23.03.71)	

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US	4559275	CH JP	659864 59009306	DE	3320753	GB	2123981
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WO	11908/93	AU FR	33567/93 2684900	EP NO	616564 942164	FI	942741
WO	7853/87	EP	269707	FR	2600125	US	4869431
US	4828184	CA	1313216	EP	354660	JP	2083051
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